Simulation of 4π Ge-Spectrometer by GEANT4

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The neutron capture and fission cross-sections of minor actinides are required in designing innovative nuclear reactors. Those cross-section data are, however, not sufficient at present. Therefore, we have started a project of "Fundamental Research and development on Neutron Cross Sections for Innovative Reactors using Advanced Radiation Measurement Technology" since last year. This project consists of (1) development of advanced measurement technology, (2) acquirement of neutron cross-sections of minor actinides, and (3) development of neutron cross-section utilization system. As for (1), we will develop a 4π Ge-spectrometer for the measurement of the capture cross-sections using a prompt gamma-ray spectroscopic method. The purpose of the present study is to estimate a performance of the 4π Ge-spectrometer.

In this spectrometer, 30 Ge detectors completely cover the solid angle surrounding a sample, consisting of two cluster detectors and four clover ones: the cluster detector contains six Ge crystals and one 6-fold segmented Ge crystal, and the clover detector has four Ge crystals. Outside of the Ge detectors is covered by BGO anti-Compton shields.

We calculate energy deposit of gamma-ray in the 4π Ge-spectrometer by GEANT4 which is a toolkit for simulating the passage of particles through matter. From the result of the calculation, absolute full energy efficiencies were deduced to be $\sim$25% for 1 MeV and $\sim$1% for 0.8-1.8-2.9 MeV cascade gamma-rays, respectively. In the conference, results of the simulation will be presented.

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